PATENT SPECIFICATION 624,369

Convention Date (Netherlands): Nov. 18, 1942.

Application Date (in United Kingdom): Aug. 8, 1946. No. 23542/46.

Complete Specification Accepted: June 7, 1949.

(Under Section 6 (1) (a) of the Patents &c. (Emergency) Act, 1939, the proviso to Section 91 (4) of the Patents and Designs Acts, 1907 to 1946, became operative on Aug. 8, 1946).

Index at Acceptance :—**Classes 82(ii)**, Gx; **and 83(iv)**, S4.

COMPLETE SPECIFICATION.

Improvements in and relating to Soldering Metals and Alloys, more particularly those that are difficult to solder.

We, N. V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organized and established under the laws of the Kingdom of the Netherlands, having our seat and office at Emmasingel, Eindhoven, Province of North Brabant, Kingdom of the Netherlands, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

It is known that in soldering metals an intimate joint between the solder and the metal to be soldered is of importance for good adherence, a certain degree of alloy formation between solder and metal surface probably playing a part in this action. In order to obtain a purely metallic surface required for a good joint, use is made of fluxes and soldering means, whose action is mainly based on the removal of surface impurities and oxides. In many cases, however, the obtaining of a perfect contact between metal and solder involves difficulties, due to which well-adhering soldered joints are difficult to obtain with such metals. Thus, for instance, it is known that in soldering aluminium and its alloys the adherence at the soldered joint may be unsatisfactory, which is ascribed to the obstinacy with which the oxide film, which is always present on the metals and prevents the contact between aluminium and solder, adheres to the aluminium and the oxide film renews itself after its removal. It has been attempted to remove the oxide film prior to or during the soldering operation by making use of special fluxes. Again it has been suggested to rub the aluminium surface thoroughly under a film of molten solder so that the solder contacts with the bare aluminium before it contacts with the air and oxidises again. Furthermore, it is known to provide the aluminium and its alloys with a solderable covering layer prior to the soldering operation proper, for instance by pickling and coating it galvanically with a metal layer such as nickel. Again, it has been described to solder aluminium articles by heating with a molten salt, which forms metal by decomposition, in the presence of a flux which removes the oxide film on the aluminium.

The common methods do not provide a satisfactory solution for providing a well-adhering soldered joint with aluminium and its alloys. The gas- and liquid-proofing by soldered joints hitherto obtained is often unsatisfactory. In soldering magnesium alloys similar difficulties are experienced as in the case of aluminium and its alloys. The difficulties experienced in soldering chromium and chromium containing alloys and other metals that are hard to solder are also ascribed to the particular nature of the metal surface, which prevents perfect joining between metal and solder.

The invention relates to a method of soldering more particularly difficultly solderable metals, in which these drawbacks inherent to aluminium and aluminium alloys, chromium and chromium containing alloys, and magnesium alloys are avoided.

In the method according to the invention use is made of a solderable intermediate layer, the material to be soldered being coated, according to the invention, with a solderable layer prior to the soldering operation by burning on a metal layer with the aid of glaze.

In soldering aluminium and aluminium alloys, chromium and chromium containing alloys, and magnesium alloys, one advantage of the above method is that the oxides present on the metal surface do not prevent a strong joint being obtained. The solderable layer may be burnt on without any preparation of the material to be soldered, i.e. directly on to the oxide film. It has been found that the methods used in the technique of soldering ceramic material may be used with success for burning on a solderable metal layer with the aid of a glaze.

Thus, for instance, a suspension of enamel

and metal, such as silver, copper, platinum, gold may be painted or sprayed on to the object to be treated and the layer obtained may be burnt in similarly as with ceramic material. The metal may be replaced by a compound readily separating out metal.

As an alternative one may first apply a layer of enamel which is subsequently rendered solderable by treatment with a metallising suspension.

When using a glaze containing metallising suspension, the properties of the enamel layer obtained are naturally dependent on the volume ratio of glaze-metal. In the case of a high glass content it may be hard to tin. When in this case the desired capacity of being soldered cannot be secured by cleaning the surface, the latter may be rendered solderable by burning on another metal layer which is free from glaze. It is also possible first to apply a glaze containing a metal suspension, followed by drying the layer obtained and coating it with a glaze-free metal suspension so that burning once is sufficient. To achieve a sufficient adherence to the material to be soldered, an excessively low glass content of the layer applied first, is undesirable.

Care should be taken, by a suitable choice of the glaze and the metallisation mass, that in burning on the solderable intermediate layer the temperature does not approach too close to the melting point of the piece of work to be soldered.

The burning on of the solderable intermediate layer may take place in a furnace into which the object to be treated is introduced as a whole. If it is not desired that the object be heated as a whole, the surfaces to be soldered may be heated locally.

The material provided with a solderable covering layer may be soldered in the usual way, for instance by means of tin solder.

Although the invention is primarily of importance for soldering aluminium and its alloys, chromium and chromium containing alloys and magnesium alloys, the principle of furnishing the material to be soldered with a solderable layer by burning on with the aid of glaze prior to the soldering operation may also be used for other metals which are difficult to solder. Thus, for instance, soldered joints may be established in the case of zirconium by first coating the latter with a solderable metal layer according to the invention. If desired, the method of soldering by means of burning on a solderable layer with the aid of glaze may also be used for metals that are known to be readily solderable. In this case, of course, the composition of the glaze and the metallisation mass should be adapted to the nature of the material to be soldered in such a manner that the latter can be coated with an adhering layer.

As appears from the following examples, the method according to the invention permits strong soldered joints to be obtained.

EXAMPLE I.

A plate of 1 sq. cm. of technical aluminium was sprayed on either side with a suspension obtained by grinding 200 gms. of a commercial borosilicate enamel which starts softening about 425° C., of the composition 5.6% SiO_2, 14.8% B_2O_3, 71.4% PbO, 1% Al_2O_3, 1.4% Zno, and remainder colouring oxides, and 2000 gms. of fine silver or silver oxide in 1000 gms. ethyleneglycol, to which is added 50 gms. of nitro-cellulose. After drying, the layer obtained was sprayed with a suspension of silver or silver oxide. After drying the second layer it was heated for about 10 minutes in a furnace at about 500° C. Then the plate was placed between two copper blocks and soldered thereto by means of soft solder in the usual way. Tearing loose the blocks thus connected through the aluminium plate required a force of about 370 kgs.

In the example given above the ratio glass-silver or silver oxide in the layer applied first was 1 : 10. In the case of a ratio 1 : 5 the force required for tearing loose the blocks was about 300 kgs/sq. cm., it being about 200 kgs/sq. cm., in the case of a ratio 2 : 5. A ratio 1 : 50 required a force of about 160 kgs/sq. cm.

When soldering in a similar manner as referred to above in regard to aluminium, a plate consisting of a corrosion-free aluminium alloy containing 0.8% magnesium, 1% silicon and 0.7% manganese, the ratio glaze/silver being 1 : 10 for the layer applied first, the required force was found to exceed 300 kgs/sq. cm.

In the case of the aluminium alloy, known under the Registered Trade Mark "Duralumin," containing 4% copper, 1.5% magnesium and 0.6% silicon the required force was about 210 kgs/sq. cm. under the same conditions.

EXAMPLE II.

In a similar manner as set out in Example I for aluminium and aluminium alloys a plate consisting of the material available commercially under the Registered Trade Mark "Elektron" (a magnesium alloy containing 6% aluminium) was soldered, the ratio enamel/silver being 1 : 10 for the layer applied first. The force required for separating the copper blocks then amounted to about 140 kgs/sq. cm.

EXAMPLE III.

When soldering, in the manner set out in Examples I and II but without spraying on a silver suspension free from enamel, a plate of a technical heat-proof ferro-chromium alloy containing about 30% of chromium, the

required force amounted to about 280 kgs/cm².

Although, according to the invention as has already been stated, it is not necessary, for instance with aluminium and aluminium alloys, chromium and chromium containing alloys, magnesium alloys, to subject the surface of the material to be soldered to a preceding treatment, the surface to be soldered may, if desired, be pickled prior to applying the solderable layer, thus enlarging the surface. As an alternative the surface to be soldered may be subjected to a sandblast operation before application of a solderable layer.

It has been found that a strong soldered joint can be obtained not only in the presence of the natural oxide film formed in the atmosphere, but even in the presence of a thicker oxide layer such as is provided on aluminium subjected to anodic oxidation. This is of importance, since it allows of soldering directly, i.e. without removing the oxide layer, to anodically oxidised aluminium, which is widely used in industry.

The invention is of much importance where sleeves or tubes of aluminium alloys, often alloys adapted for extrusion by impact, are often used for coils, transformers, potentiometers or the like. When the sleeve or tube and the corresponding cover are furnished with a solderable layer according to the invention they may be soldered together by means of soft solder in the usual way. The closure obtained is perfectly impermeable to water vapour or oil, even under tropical conditions. In contradistinction to former methods of sealing, for instance those on the basis of asphalt, the joint is very strong. In electrolytic condensers the usual rubber closure between aluminium vessel and cover may also be replaced, with advantage, by soldering them together according to the invention.

Since, in the case of a sufficient metal content, the solderable metal layer is a good electrical conductor, the soldering method may also be used in the construction and assembly of electrical parts, which must be so secured together as to be electrically conducting.

However, the invention also offers many possibilities beyond the field of the electric art in view of the extensive use of aluminium and its alloys in various fields, for instance for kitchen utensils, household articles, in the tinning and transport industries.

The application of a solderable layer according to the invention has been set out before from the point of view of soldering, as a preliminary step in interconnecting work pieces by soldering. However, a solderable layer according to the invention may also be used when a layer should be provided, by means of molten metal, on a metal substratum. For instance, when aluminium or an aluminium alloy should be coated with a layer of zinc, by dipping in molten zinc, the aluminium may be coated with a solderable layer according to the invention before treating it with molten zinc; in this case, the fact that the solderable layer is electrically conducting may be advantageous.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A method of coating metals with a solderable layer, more particularly those metals solderable with difficulty, such as aluminium and aluminium alloys, chromium and chromium alloys, and magnesium alloys, in which a metal layer is burnt on with the aid of glaze.

2. A method as claimed in Claim 1, in which a layer consisting of a mixture of glaze and metallising mass, for instance silver-plating mass, is burnt on and is coated with a further layer of metallising mass, if desired.

3. A method of coating aluminium, aluminium alloys or magnesium alloys with a solderable layer as claimed in Claim 1 or 2, in which the solderable layer is burnt on to an oxide film formed by artificial oxidation of the metal.

4. A method of soldering metals, more particularly metals solderable with difficulty such as aluminium and aluminium alloys, chromium and chromium containing alloys, and magnesium alloys, in which the metal surface to be soldered is coated with a solderable layer, before the soldering operation, by means of the method as described in any of Claims 1 to 3.

5. A piece of work, coated with a solderable layer obtained according to any of Claims 1 to 3.

6. A piece of work, whose metal surface is coated with a solderable metal layer containing glaze.

7. A work piece comprising a metal part, which is secured by soldering to another part, and comprises, more particularly, metal solderable with difficulty such as aluminium and aluminium alloys, chromium and chromium containing alloys, and magnesium alloys, in which a layer of glaze is provided between the solder and the metal.

8. A method of coating metals with a solderable layer, substantially as described.

9. A piece of work substantially as described.

Dated this 8th day of August, 1946.

T. D. THREADGOLD,
Chartered Patent Agent,
Century House,
Shaftesbury Avenue, London, W.C.2,
Agent for the Applicants.

Abingdon: Printed for His Majesty's Stationery Office, by Burgess & Son.—1949.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies, price 2s. 0d. each (inland) 2s. 1d. (abroad) may be obtained.